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Nebraska's Test-Hole Drilling Program and Records

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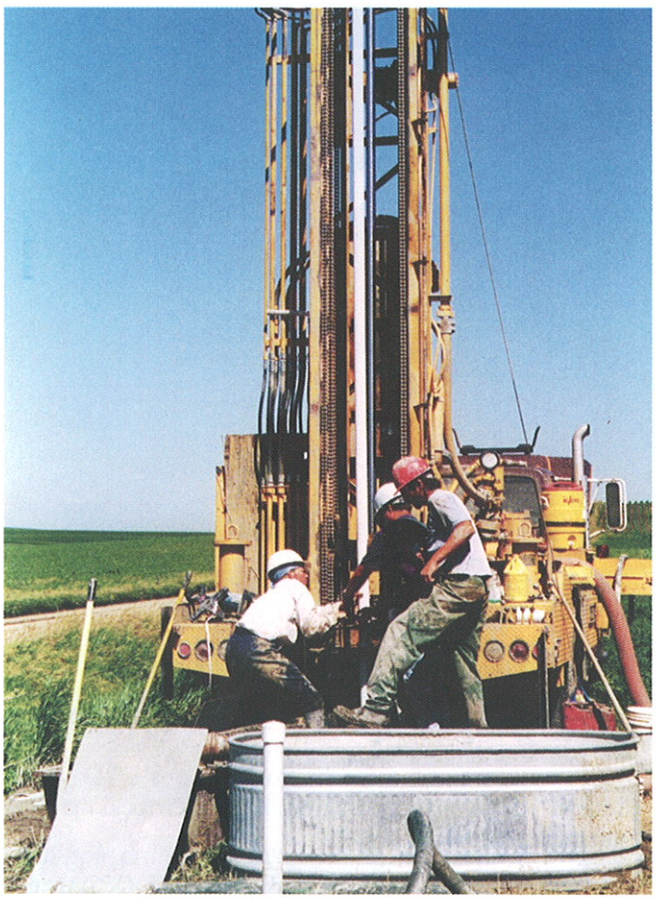
In 1930, the Conservation and Survey Division (CSD) and the U.S. Geological Survey began a program of cooperative groundwater studies in Nebraska. Since then, to assist this program and others, test drilling by rotary drilling or coring equipment has been an integral part of CSD's role. To date, about 4,900 test holes have been drilled in Nebraska, yielding extensive records called "logs."

This drilling and its records are crucial to the division's mission and a wide range of Earth science investigations. Test drilling is often long, hard work in the heat or, occasionally, in near- or subfreezing temperatures. It requires constant supervision and concentration and can be dangerous. It often goes on well beyond a normal quitting time and generally occurs miles from the nearest town. Water for drilling mud, a necessity, is carried in a separate truck. Shelter and rest are often a drive of an hour or more away.

CSD faculty and staff install observation wells in Pierce County for the Lower Elkhorn Natural Resources District in 1997. Drill rig sits directly behind workers. Water tank is in the foreground. Even during well installation, drilling samples are generally caught and recorded. CSD photo.



Test-hole logging includes stopwatch timing of each 5-foot increment of drilling and removal of cuttings at intervals of 5 feet or less. Cuttings are caught in a sieve. Then they are washed, described by sediment size (clay, silt, sand, gravel) and evaluated for color by comparison with standardized charts. If the crew is drilling elsewhere the next day, the geophysical logging must be done then and there, often running to midnight or later. Called "e-logs," these are records of electrical resistance, spontaneous electrical potential and other characteristics taken down the hole that, combined with drill cuttings and their descriptions, offer clues to nearby subsurface sediment.

The samples and records are kept on file with the Conservation and Survey Division. Starting with the original notes made during drilling, geologists then carefully examine cores and samples in the CSD archives to confirm or revise the initial description. If drillers make a geophysical log, samples are also compared to it.

The CSD test-hole log books are being updated on a county basis. They include, with some exceptions, logs of all holes drilled by CSD and its cooperators, which includes organizations such as the U.S. Geological Survey, the state's natural resources districts, the state departments of Environmental Quality or Natural Resources and others.

The records provide the most fundamental data on the framework geology of a region, which, among other things, determines much about the dynamics, quantity and quality of groundwater and surface water. They also assist in understanding rock layers and structure, ancient life and environments and geophysical data that helps evaluate land and water resources. The records also help provide the basis for applied research such as natural-hazard mitigation, building- or landfill-site evaluation and minerals exploration. The test-hole records accurately reflect subsurface conditions only where the test holes were drilled. Interpretive information on probable subsurface conditions between test holes is available in various CSD publications and by consultation with CSD scientists.

Each hole is assigned a number in the field (for example #37-B-71 as in figs. 1, 2 and 3) and is located by the land division system of the U.S. Bureau of Land Management. Locations of test holes east of the 6th principal meridian, passing north-south through Columbus, are preceded by a capital letter A. Those west of the principal meridian have no preceding letter. The first number is the township, the second the range, and the third the section. Letters that follow indicate location within the section, in order of the quarter section, the quarter-

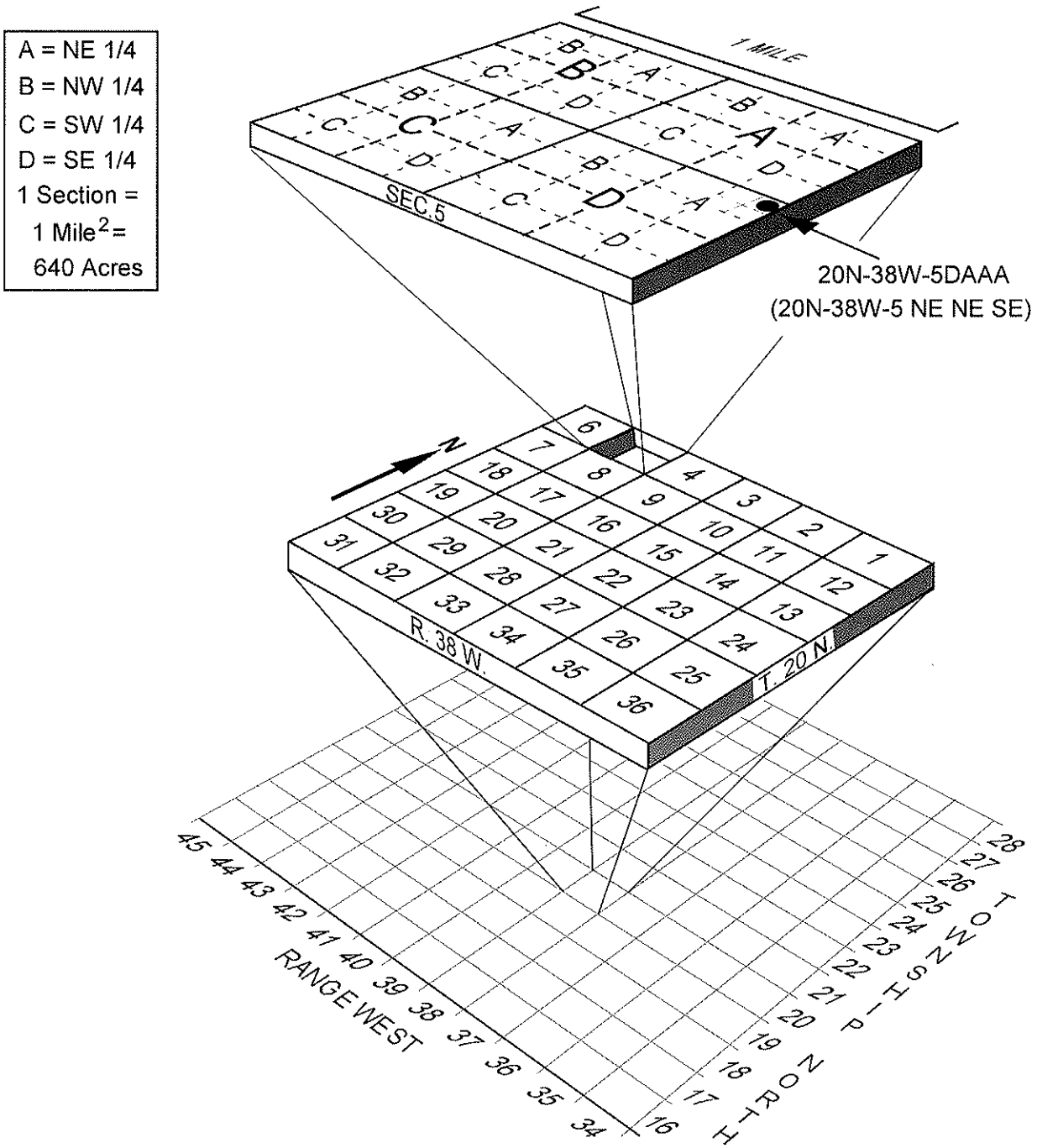


Figure 1. The U.S. Bureau of Land Management system for locating test holes used by the Conservation and Survey Division. This resembles standard legal descriptions but substitutes letters for quarter, quarter-quarter and quarter-quarter-quarter sections and so on.

quarter section and so on (fig. 1). Letters are applied counterclockwise beginning with the northeast quadrant (A). The last number is the serial number of the test hole. Figure 1 shows the correlation between this system and the one used more commonly by Nebraska citizens and government.

A typical summary log listing sediment size and distribution by depth appears in figure 2. Test holes that have been logged geophysically are so noted (as e-logs). These geophysical logs often can be used to determine formation boundaries more precisely than by field sampling. Departures of the curves from the center lines may often indicate that clastic sediments (those made of fragments of other rocks) are becoming coarser grained (fig. 3).

Test Hole #37-B-71 (E-logs)
(20N-38W-5daaa)
Arthur County

Location: NE NE NE SE sec. 5, T. 20 N., R. 38 W., approximately 2,400 ft. north and 45 ft. west of southeast corner.
Ground elevation: 3,680 ft. (t) (KC Lake 7.5-min. quadrangle)
Depth to water: 11.9 ft. (9-10-71)

	Depth, in feet From	To
Quaternary System and Tertiary System - Pliocene Series, undifferentiated:		
Sand, very fine to fine, slightly to very silty, brownish black to gray brown	0.0	15.0
Sand, very fine to fine, trace medium, in part slightly silty, light grayish brown	15.0	67.0
Sand, very fine to medium, very silty, slightly clayey, dark grayish brown	67.0	80.0
Sand, very fine to medium, light gray brown	80.0	92.0
Silt, very sandy, very fine to medium, slightly silty, greenish gray	92.0	101.0

Figure 2. Example of part of a test-hole log (The note in parenthesis right after the test-hole number means that geophysical logs are available for this test hole. Test-hole location is listed by the U.S. Bureau of Land Management system underneath the test-hole number – see previous page.)

Test-hole drilling means catching, recording and bagging samples on site. Both samples and their records are kept on file at CSD. These are then checked and revised before a county test-hole log book is published. CSD photo.

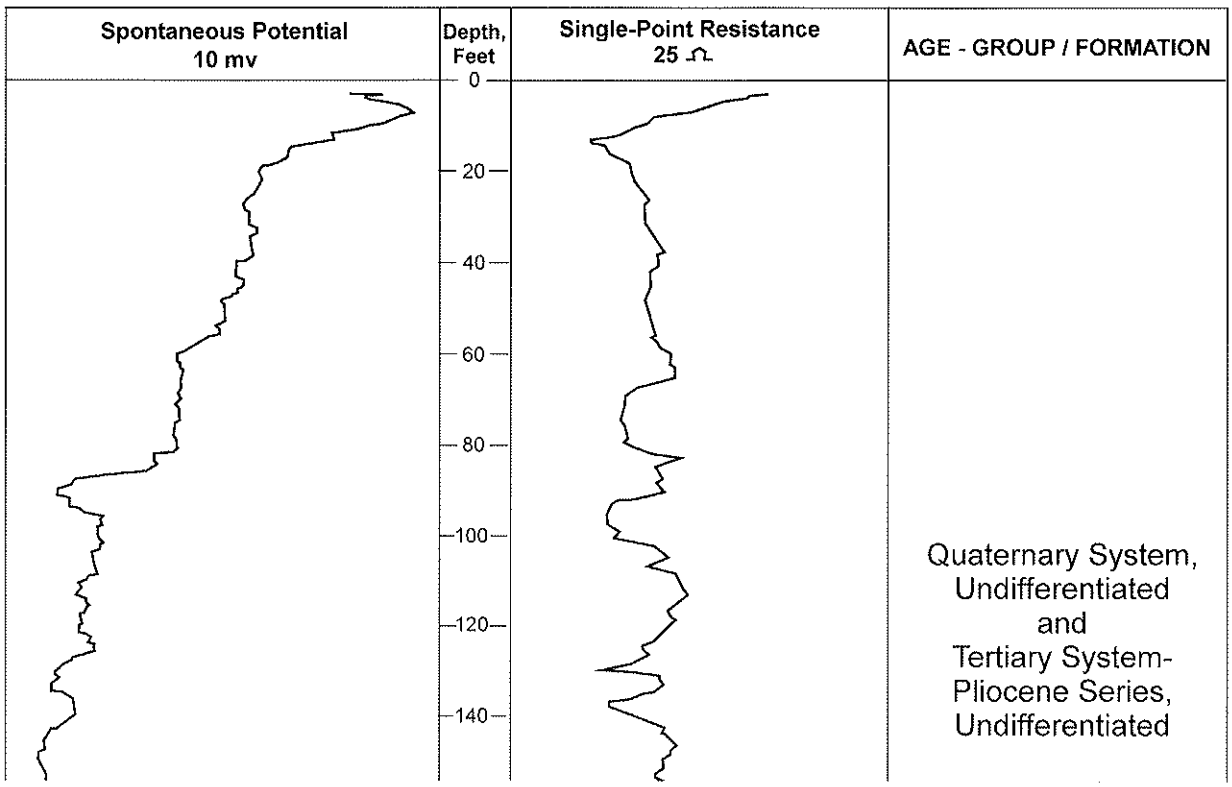


Figure 3. Part of the geophysical log, or "e-log," for test hole #37-B-71 at 20N-38W-5daaa (Arthur County) in the U.S. Bureau of Land Management location system (smaller than actual size); see figs. 1 and 2.

Status of Test-hole Log Books

Our goal at CSD is to update and publish a test-hole log book for each of Nebraska's 93 counties. As of March 2001, progress on test-hole log books is as follows:

- 76 counties have been updated and are for sale;
- 5 are in progress;
- 4 older log books remain;
- 8 log books are unpublished but available for review at the Lincoln office of CSD.

For the most current listing of all county log books, see the Conservation and Survey Division publication catalog at *http://csd.unl.edu/csd/pubcatalog/thr.htm.*

Geologic samples from the test-holes, as well as samples and cores from many other sources, can be reviewed at CSD's Lincoln office (CSD's sample collection is detailed in another fact sheet).

Acknowledgments and References

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Ordering and Further Information

To order one or more county test-hole log book(s), write to CSD and request a free publications catalog.

Conservation and Survey Division: 402-472-3471
Fax: 402-472-4608 Publications: 402-472-7523
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